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PHYSIOLOGY VERSUS *NATURAL SELECTION: AN UNNATURAL ANTITHESIS.*

Colour in Nature: a Study in Biology. By Marion I. Newbigin, D.Sc. (Lond.). Pp. xii + 344. (London: John Murray, 1898.)

THE authoress states in the preface that her object is "to set forth in systematic order the main facts at present known in regard to the Pigments and Colours of Plants and Animals," and especially to treat the physiological side of the subject, and bring together the scattered literature which deals with it.

The first three chapters are introductory, dealing with general questions of importance for the remainder of the work—such as the differences between pigmental and structural colours, and the classification of both these categories. Colours and pigments are then considered throughout the plant and animal worlds, the subjects treated in consecutive chapters being plants; Protozoa sponges and Cœlentera; worms; Crustacea and Echinodermata; Lepidoptera; insects in general and spiders; Mollusca and invertebrates generally; fish; amphibians and reptiles; birds (occupying two chapters); mammals and the origin of pigments. The concluding chapter "on the relation of facts to theories" contains a general summary and a brief exposition and criticism of various theories as to the origin of colour. The list of references, admitted to be incomplete, will nevertheless be useful, although it is to be hoped that in a future edition mention will be made of Colonel Swinhoe's complete paper "On the Mimetic Forms," &c., in the *Linnean Journal*, instead of to the brief abstract in the *Proc. Roy. Soc.*

The writer again and again protests against the interpretation of colour phenomena by natural selection, and implies that those who incline to accept this interpretation are satisfied with casual suggestions which they make no attempt to test. The present writer believes that the exact opposite is the truth, and that in the whole history of biological thought no theoretical suggestions have been so fruitful of extended and precise observations as those based upon this very hypothesis.

Whenever a writer ventures to suggest such an interpretation, it is assumed by opponents that he is satisfied to leave the matter at this point without the thought of any further investigation by way of confirmation. This is an assumption, and a most unfair assumption. Those who have found natural selection a sure guide to research, who cannot pursue all the varied lines which it indicates, are glad to offer the same inspiration to other workers. "A few magic words upon natural selection" (p. 24) are not intended to "dismiss" any problem in natural history, but rather to suggest lines of research by which it may be attacked.

It is interesting to note that this extremely critical attitude as regards natural selection is not accompanied by any special reticence in the use of other hypotheses. Thus, as regards birds and butterflies, "the fact of the exquisite structural coloration and a wonderful development of structures arising from the cuticle, suggests that the structural colours are merely a result of extreme differentiation of the cuticle, and therefore produced by the same cause which gave rise to this differentiation" (p. 11).

Again, on p. 155, the persistence of green pigments derived from the larval food into the ova (and, in fact, into the young which hatch from them) is quoted from the present writer; and the authoress then proceeds to suggest that the green colour found by Mr. F. Gowland Hopkins in the *Pierinae* is of the same kind. This unsupported suggestion is very probably sound, and had been independently arrived at by the present writer, who is also inclined to extend it to the green pigments doubtless derived from the blood (hæmolymph), which are stored, as in the *Pierinae*, between the two wing membranes, and give rise to the bright green or sometimes blue-green bands or spots in certain *Nymphalinae* (*Colaenis dido*, *Victorina steneles*) and *Papilioninae* (*P. sarpedon*, &c.). Such a suggestion is reasonable, and may well lead to specially directed research; but a similar spur to inquiry, if based on the theory of natural selection, would have been held up to contempt by the authoress.

The freedom with which even flimsy and worthless speculation is indulged in, if only an explanation founded on natural selection can be thereby avoided, is well seen on pages 161 and 162, where the warning colours of *Heliconidae* and the mimetic or convergent *Pierinae* are briefly discussed. The writer suggests that the slow flight and warning colour of *Heliconidae* and their mimics are due to "the relatively low organisation which renders pigmentation by waste products possible, which makes brilliant optical colours impossible."

First, as to "low organisation," the Insecta are admittedly among the most specialised of animals; excepting the Diptera there are no more specialised insects than the Lepidoptera; among Lepidoptera the *Ithomiinae* (Bates' *Danaoid Heliconidae*, Trimen's *Heliconoid Danaidae*) are the most specialised, and the *Heliconinae* proper (Bates' *Acraeoid Heliconidae*) only less so.

Secondly, as to "pigmentation by waste products," Mr. Gowland Hopkins' observations prove that the pigments of the *Heliconidae* are *not* the same as those of the Pierines which resemble them. The latter alone have been shown to possess wing pigments of uric acid or substances allied to it.

Thirdly, as to brilliant optical colours being rendered impossible. There are numerous examples of iridescence in *Ithomiinae*, and some structural blues in the far less numerous *Heliconinae* proper, while in the *Danainae* which are closely related to the former the structural blues of many much-mimicked *Euploeina* are magnificently developed.

The writer is apparently desirous of rejecting an interpretation which explains an immense body of facts, and has led to the discovery of an immense number more, in order to substitute a crude suggestion which, for its mere statement, requires the distortion of many well ascertained facts.

It is only fair to add, however, that the writer recog-

nises and clearly points out the obvious difficulty that the resemblances in pattern are not to be explained by her hypothesis.

Similar bias is shown in the prominence given to unimportant and often partisan statements; while the original evidence on which an opposite conclusion has been based is neglected or barely alluded to.

Thus, referring to the variable coloration of caterpillars, we read on p. 147: "According to recent research, it is not so much the colour of the environment which directly affects the larvæ as the intensity of the light" (see Garbowski). To the conclusive experiments upon which an opposite contention is based no allusion is made, the bias of the writer permitting nothing more than a vague reference to "popular books besides those already mentioned." But, on the strength of the statement quoted above, we are treated with reflections upon the errors of a simple explanation in biology.

Again, on p. 325, in reference to the artifically produced variations in the colours of butterflies, we are told that "competent entomologists (*e.g.* Garbowski) are of opinion that the new colours have little or no phylogenetic importance," without the slightest indication that highly competent authorities have given very good reasons for an opposite conclusion. In fact, if the writer agrees with an authority, it is sufficient to quote his opinion without his reasons, and, above all, without any of the reasons which point in another direction.

The references to Piepers' easily answered and often superficial objections to the theory of mimicry (pp. 316–321) are given at considerable length, and the reader unacquainted with the subject might well suppose, from the writer's concluding remarks, that serious difficulties had been raised.

In a similar spirit the writer speaks of "the (by hypothesis) well-protected *Heliconidae*" (p. 149), thus assuming an assumption on the part of those who seek an interpretation based upon natural selection, and neglecting the considerable body of evidence, direct as well as indirect, which has been brought together.

The use of the contemptuous "so-called" occasionally recalls the jest about the "so-called nineteenth century."

The statement of the procedure of the Darwinian school (p. 306), in attempting to solve the problems of colour, is the merest travesty, quite unworthy of serious comment.

Apart from the obvious bias of the writer in dealing with natural selection, of which numerous other examples might have been adduced, the work is likely to be useful. The most interesting and valuable parts are those dealing with subjects which the authoress has herself investigated, such as the structural colours of birds' feathers. The book is, in fact, not a well-balanced and judicial account of the subject, "Colour in Nature," but an interesting exposition of those parts of her subject with which the authoress is in sympathy, other parts being either distorted or omitted. In the former category would doubtless be placed the interpretation of external colour, as the expression of internal structure, of which a single example is given on p. 226, and it is therefore remarkable that no reference is made to the numerous examples which the late Alfred Tylor was accustomed to explain in this manner.

The book is clearly printed, with few printer's errors, and the small number of simple illustrations sufficiently explain the writer's meaning. E. B. P.

THE GROWTH OF ANIMAL AND VEGETABLE ORGANISMS.

Experimental Morphology. By Charles Benedict Davenport, Ph.D., Instructor in Zoology in Harvard University. Part 2. Pp. xviii+281 to 508. (New York: Macmillan Company; London: Macmillan and Co., Ltd., 1899.)

THE second part of Dr. Davenport's work—the first part appeared two years ago and was noticed in NATURE, October 14, 1897—deals exclusively with the effect of chemical and physical agents upon the growth of animal and plant organisms. In the preface the author draws attention to the importance of the study of the conditions which affect growth. "The possibility of increasing the human race beyond limits that are not far off depends upon a better knowledge of the conditions of growth. The reader has only to consider that the world's supply of 2500 million bushels of wheat, 2000 million bushels of maize, 90 million tons of potatoes, and its untold millions of tons of beef, pork, and fish are reproduced each year by growth." This importance has recently been emphasised by the remarkable result of Sir William Crookes' researches into the statistics of the world's wheat supply as set forth in his presidential address at the Bristol meeting of the British Association, and the controversy to which that address has given rise. Dr. Davenport selects as his definition of growth "increase in volume," a definition which is by no means safe from criticism. Although we all think we understand what is meant when growth is spoken of, biologists have been by no means in agreement as to how exactly it should be defined. Thus, as the author points out, while Huxley spoke of growth as "increase in size," Sachs regards the volume increase as necessarily intimately associated with change of form, while Pfeffer takes the qualifying part of Sachs' definition, and defines growth as change in form only, and this is accepted by Vines, who adds: "accompanied usually by increase in bulk." To us this definition appears far more satisfactory, even if it is associated with the idea of development, than the more limited definition adopted by Davenport. In the animal organism especially is it difficult to exclude the idea of change of form in association with growth, nor does it seem reasonable to place a mere swelling due to imbibition of water or to distension with gas upon the same footing as a new formation of bioplasm.

The book before us is, however, almost entirely concerned with vegetable organisms, in which, no doubt, the imbibition of water plays a much more important part in the process of growth than it is apt to do in animals. And as a matter of fact the percentage of water in many animal embryos undergoes a steady decrease as development and growth proceed.

With regard to the effect of chemical agents upon growth, one of the most interesting parts of the work is that dealing with the supply of nitrogen to growing plants, whether it be offered to them in the form of a salt